THE EFFECT OF PREJUDICED MEMORY IN STRATEGIES FOR SOCIAL INTERACTION

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ABSTRACT

In human society, the majority of individuals try to achieve objectives that are individual to them, carrying this out, in the majority of cases, in an independent manner. It has in fact been repeatedly verified that some individuals are able to function as catalysts, introducing ideas and technology that go against the ideological currents that govern their social relationships. A variety of factors can be indicated as being partly responsible for this capacity for innovation and social adaptation, one of them being the perpetuation of collective memory by means of written texts, the press, and by all the different new types of media that we have today at our disposal, and which are used by certain individuals in determined contexts to obtain some type of advantage. What effect, however, would prejudice have when applied to strategies of interaction in a social network? Prejudice is something that is generally considered to be pejorative. Taking the free circulation of information amongst individuals within a social network as a basic premise, would it be possible to affirm that we would always achieve improved performance of society as a whole when the collective memory is loaded with prejudice? This work attempts to provide an answer to that question, analysing the relationship between the efficiency of a social network and the memories of the individuals who make it up, when the network itself is not immune from information that is (potentially) incorrect.

KEYWORDS

Prejudice, Social Networks, Multi-Agent System

1. INTRODUCTION

History is full of the names of people who made a difference. Inventors such as the Wright brothers, Einstein, and many others, who acted as catalysts of change by presenting technologies that disrupted the ideological currents that governed their social relationships. According to Adam Smith, cooperation between individuals takes place even when the individuals are trying to achieve objectives that are specific to them, it being sufficient that the results of this cooperation maximizes profit. In other words, if there is an advantage to cooperating, individuals tend naturally to do it (Dugatkin, 2000). The perpetuation of collective memory by written texts, the press and all the different types of new media that are available to us today permits the sharing of information, which serves to "inform" or reduce uncertainties within determined contexts (Hackbarth, and 1999). In a deeper look at social networks nowadays, and at the individual's abilities to make decisions using collective memory, we arrive at the definition of collective intelligence raised by Pierre Lévi (Lévy, 1998), "An intelligence distributed everywhere: that is our initial axiom. Nobody knows everything, everybody knows something, all there is to know is found within humanity." But when the individual capacity to validate facts that they think they know is limited, so that part of the information that is circulating on the social network is biased or even wrong, what happens to the collective intelligence? If collective intelligence is the capacity to decide based on collective memory, but is not fully reliable, what type of individuals (agents) would make the social network more efficient? What effect would prejudice have when applied to strategies of interaction in a social network? Prejudice is something that is generally considered to be pejorative. Now, taking as a basic premise the free circulation of information between individuals in a social network, would it be possible to affirm that a model in which that network was essentially cooperative would always achieve better results than one that is essentially competitive, when the collective memory is loaded with prejudice? The work presented here attempts to act as a base from which to

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find an answer to that question, analysing the relationship between the efficiency of a social network and the memories of the individuals who make it up, when the network itself is not immune to information that is (potentially) incorrect. We start by defining two main types of individual memory (short term memory and working memory). A Multi-Agent System (the Where's Wally game) has been created where agents, having a limited sensorial range, try to find their partner by asking other agents who are in the vicinity whether they "saw agent X". The goal of the simulation is to see if it is preferable to have a cooperative or a competitive model for a social network, when the social interactions between the agents rely on a Prejudiced collective memory.

2. DEFINITIONS FOR MEMORY AND PREJUDICE

We define Prejudice (or Preconception), P with two complimentary propositions:

P1: (Prejudice is) believing sincerely in something without having checked the correctness of that belief;

P2: (Prejudice is) Generalizing a belief (creation of stereotypes).

In conceiving the model for the group of experiments presented in this work, the definition of social network is that of a group of individuals (agents) with the ability to interact amongst themselves and of storing information and facts that are relevant to the process of that interaction. Social networks are one of the bases of organizational networks. According to Mitchell (1969), "a social network is a specific set of linkages among a set of persons, with the additional property that the characteristics of these linkages as a whole may be used to interpret the social behaviour of the persons involved. We now move towards having a possible definition of the Efficiency of a Social Network, based on the literature from Economics (see for ex. Jackson, 2003). In our case, we define a measure of Efficiency of a Social Network (ESN), as being "the quantity of individuals (agents) who managed to achieve their objectives within a determined period of time per total number of agents (population)". We will formalize ESN as a measure of efficiency in the context of this work, later on. The objectives that the Agents have can, in turn, be (i) Independent or (ii) Dependent. From these definitions we can see that according to (i) objectives can be as simple as (i) the mere survival of the agent (behaviour that is essentially self-centred) and which in accordance with (ii), "teamwork", (cooperative, altruistic behaviour) – as in soccer – is essential in order to achieve good results. In addition, we have defined memory as taking the following forms: A) Individual Memory; B) collective memory. Individual memory (A) can be sub-divided into: A.i) Short-term Memory and A.ii) Working Memory. The reason for defining memory this way is that it allows us to separate the capacity for immediate perception of the habitat with the capacity to make deductions from known information. That is, we can define the following premises relating to memory depending on whether it deals with individual or collective memory. The first two premises (A.i and A.ii) relate to each of the components of individual memory:

Premise A.i, Short-term Memory *gathers sensorial information. It permits a reactive response that makes use of the rules present in the working memory.*

Premise (A.ii) Working Memory is the memory that permits the processing of the facts acquired for the posterior creation of new rules.

In a similar manner, collective memory (B) was divided into two aspects identified as premises B.i and B.ii:

Premise (B.i) communication allows for individual access to the memory of other individuals;

Premise (B.ii) collective memory can be built by means of historical registers, i.e. logs. (This type of registration of the past was not applied to this study. The study of the "weight of history" will be left to be dealt with in future works).

3. METHODOLOGY AND MAIN QUESTIONS

In the literature relating to Multi-Agent Systems (e.g. Ferber, 1999), an agent is usually seen as an entity that lives in an environment and who is capable of interacting with other agents. Many of these characteristics are related to cognitive capabilities and prejudice (Noto et. Al, 2003). The configuration of the Multi-Agent System presented in this work was carried out using the following analogy: imagine that all agents (individuals) go to a party, but they lose track of their partner. If the agents have a limited sensorial range, what do they need to do in order to find their partner in the most effective way? One simple way of doing it is to make the agents ask other agents who are in the vicinity whether they “saw agent X”, and according to the answer given, move in that general direction. But which is most effective - to remember a lot of events and transmit that information when asked, or not to do so? This approach allows us to build a simulation in which the agents “remember” the interactions that they had with other agents. But if the agents don't transmit temporal information so that other agents can validate the information, or taking into account that what is being transmitted can be outdated – being exposed to the available information can be counterproductive, preventing some agents from ever achieving their own objectives. Looking at this model globally, one could start to infer the answer to the following questions: Is it preferable to have agents with a lot of individual memory, or with less memory (when it could contain incorrect data)? Is it preferable to have a cooperative or a competitive model for a social network, when the social interactions between the agents rely on a Prejudiced collective memory? Is there some optimal relationship between the percentage of individual memory used for fixed rules and the percentage of incorrect data of the information flow in a social network?In this first work, all of the agents, who are called Wally[X], have objectives which (for X:=1 to Population) are independent. This means that all agents try to achieve goals that only them selves are interested in. (The goal of an agent is to find another agent, who is chosen randomly). If agents were not aware of each fact, they would be in possession of a variable, but measurable, quantity of “erroneous facts”. It is enough, for this, that an agent (A) asks another agent (B) if they have seen agent (C). The reply “he’s over there, in (X,Y)”, (X and Y being the geographical coordinates of the location of agent C), we now have the possibility to be led into error, as the target agent may, in the meantime, have moved, being therefore in a completely different position to that initially referred to as (X,Y). For it to be possible to model P2, the choice was made to endow the agents with a group of characteristics that would be pretty much visible to the other agents, depending on the distance at which they were. The analogy used was that of the direct observation of a person walking towards us: from a distance we can see the colour of their clothes; as they get closer, we can see the colour of their hair, until finally, we can see the colour of their eyes, if they get close enough to us. With this in mind, a group of characteristics was defined for one agent as if it were a generic group of five characteristics (A1 to A5), in which each one is defined in a 0-10 integer scale. The position of the agent is added to these five generic characteristics, given by the coordinates (X,Y), and its name (ID). It was agreed that when an agent interacts with another agent once (in which the distance between them is zero) the agents gets to know his ID as well as all the characteristics that the agent has at the moment of meeting. We can therefore define the basic structure of a Wally[X] agent as being: Agents = record {Id; ShortTermMemory; WorkingMemory; Position; Goal; Goal Achieved} in which the MaxSTM and the MaxWM correspond to the “Maximum Short-term Memory” and “Maximum Working Memory” respectively. The “habitat” of the agents is defined by: Matrix = array[1..WorldMaxX, 1..WorldMaxY] of integer; with WorldMaxX = 30 and WorldMaxY = 30. The sensorial capacity of the agents can also be given parameters, so that the flow of data received can be controlled. For this reason, an agent is only able to “see” as far as a horizon of five positions (cells of the matrix). Therefore if we count the positions around the agent, we have five possible values for each distance d((X0,Y0);(X1,Y1)). The group of experiments consists of varying the parameters of the WorkingMemory and ShortTermMemory, as well as the position of a determined number of agents. We have considered Prejudice as the total number of facts (Wally[X] is believed to be at position(CoordX, CoordY)) present in collective memory that are nevertheless wrong. Computation of the experiments' average values for some of the variables mentioned above was also done.

4. MAIN ALGORITHM

The main algorithm is structured as follows:

```
ALGORITHM Where_is_Wally
 WHILE (( Time < EndOfParty) AND ActivePopulation > 0 )) DO
  Time:=Time+1:
  Cleanup_Collective_Memory_Older_Than(Remember);
  ActivePopulation:=Check_For_Active_Population();
  Initialize_Party_State(Time);
  FOR X:=1 TO Population DO
   IF (Wally[X].GoalAchieved=FALSE) THEN
    Check_Collective_Memory_Relative_To(X);

Look_Around_For(Wally[X].Position.X,Wally[X].Position.Y,Wally[X
].Goal);
    IF (Wally[X].GoalAchieved=FALSE) THEN
     Ask_neighbours_about_my_goal(X);
     IF ((ShortTermMemory_Contents(X)=0) AND
(WorkingMemory(X)=0) THEN
      move_randomly(X);
     ELSE
      IF (goal_is_in_WorkingMemory(X)>0) THEN
       IF ((WorkingMemory_Contents(X)>0) AND
(validate_goal(X,goal_is_in_WorkingMemory(X))) THEN
        move_towards_goal(X,goal_is_in_WorkingMemory(X));
       END IF;
      ELSE
       move_towards_similar_entry_in_ShortTermMemory(X);
      END IF;
     END IF;
    END IF;
   END IF;
  END FOR;
 END WHILE;
END.
```

5. RESULTS

By running the simulation for different values of WorkingMemorySize (WMS) as defined before, a file containing the results produced by 2492 simulations was analysed. The Pearson correlations between the variables defined above have computed. It is important to mention that Pearson correlation between WMS (Working Memory Size) and MediumPrejudice is high (0.94). In order to measure the amount of prejudice involved in the simulation, a measure of the prejudice by memory (PBM) was computed, being given by the following equation:

$$PBM = \frac{\frac{Medium\ Prejudice}{Population}}{\frac{MediumTotalSTMUsage + MediumTotalWMUsage + MediumEmailsAnswered}{MediumEmailsAnswered + MediumEmailsSent}}$$

This measure captures the cost of the search for Wally, taking in account the number of known facts, as mentioned above. In addition, a measure of the efficiency of the social network (ESN) was also computed, as being the number of the inactive individuals: ESN=Population-ActivePopulation. Since active population is the number of individuals still seeking for their goal of “finding Wally”, then the remaining individuals (the inactive) are the ones that already achieved this goal. The Pearson correlation coefficient between these two measures (PBM and ESN) is approximately 0,75, revealing the direct association between the two measures. It is possible to determine a statistical model to this relation: ESN= 427,88 PBM - 8,90 29, based on the fitting of a regression line over the dispersion diagram of the two variables.

6. CONCLUSIONS/FUTURE PERSPECTIVES

The amount of information available is a factor that must definitely be taken into account in future work. However, when the veracity of the available information provided by other agents cannot be ensured, the model has shown that discrete phenomena occurred relating to those individuals who obtained the best results, given the fact that some agents had created clusters/ghettos, opened the way to agents who were less attached to the prejudices. As Noto et. *al*, 2003, state, "(...) Prejudice may be studied as a mechanism for generating knowledge starting from existing one. To a large extent, its utility is conditioned to the probability of error occurring during the process of generation, what equals to saying that prejudice may evolve in low-error phases, but may become useless as error grows in knowledge generation (...)". Nevertheless, what this work seems to show even in this early stage is that prejudice can act as a way of increase the efficiency of a social network. In other words, the response that the model seems to be showing us is that in a world loaded with information, in which the reliability of the available information is not guaranteed, prejudice functions in favour of those individuals who are strongly attached to objectives that are not directly affected by it. Although this conclusion seems quite surprising, it borrows explanation from the areas of organizational theories, namely organizational inertia, since prejudice can be seen as a form of inertia. Hannan and Freeman (1988) introduced the concept of structural inertia, stating that “structures of organizations have high inertia when the speed of reorganization is much lower than the rate at which environmental conditions change”. Therefore, a society that has prejudices can be bad for the individual, given that many are not going to achieve their individual objectives; but it does not have to be bad for that society, as some individuals may go on to achieve their objectives much faster. In future works, the creation of simplified models should be done, so we can be assured that no other variables are affecting the results.

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